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RELATIVE ABUNDANCE AND LENGTH-WEIGHT RELATIONSHIP OF *CLARIAS BUTHUPOGON* AND *HETEROBRANCHUS LONGIFILIS* IN ASA RIVER, ILORIN, KWARA STATE, NIGERIA

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ABSTRACT

The relative abundance and length-weight relationship of *Clarias buthupogon* and *Heterobranchus longifilis* were studied in Asa River, Ilorin, Nigeria, between April, 2011 and March, 2013, using standard laboratory procedures. Generally, *C. buthupogon* and *H. longifilis* were fairly distributed in Asa River with percentage compositions of 50.29% and 49.71% respectively. There were more fishes at downstream B compared to downstream A and more catch was experienced during the rainy season compared to dry season. The correlation coefficient (r^2) between length and weight relationship was significantly high ($P<0.05$) and ranged between 0.644 and 0.908 for *C. buthupogon* and, between 0.235 and 0.908 for *H. longifilis*, with their regression coefficient (b) values ranged between 1.19 and 3.59 for *C. buthupogon* and, between 2.19 and 4.81 for *H. longifilis*, a deviation from the standard value of 3, revealing positive and negative allometric growth. Generally, weight increases faster than the length.

KEYWORDS: *Clarrids*, Length, Weight, Relationship, Asa River, Ilorin, Kwara State, Nigeria

INTRODUCTION

The global demand for animal protein has increased because of geometrical growth in human population along with decline agricultural productivity. Fisheries are an important contributor to animal protein needs. The rational and scientific management of fisheries depend on a fundamental understanding of fish biology and ecology. Among the various biological aspects of fish, the length-weight relationship is of importance in the management of both culture and captive fisheries. The yield of fish is usually studied using weight as a measure of size. Fish grows both in length as well as in bulk, and length is easier to measure and so often used along with weight in growth studies. Length and weight are related by a power relationship and the equation relating length to weight gives some indication of the growth pattern of fish in a population. The length-weight relationship has both applied and pure applications in the fisheries industry. Market sampling of fish of commercial importance often measures the length, as fish are usually gutted and life weight cannot be measured with certainty. An estimate of it can be obtained using predetermined length-weight regression.

Nigeria as the largest consumer of fish in Africa needs to increase its domestic fish population. Nigeria's fresh water surface area is estimated at 14,991,800 hectres (Ita, 1993), which is about 12.4% of its surface area (94,185,000 hectres) (Olaosebikan and Raji, 1998). These water bodies constitutes source of fish supply from inland fisheries; including the lakes, rivers, streams etc. Since most of the Nigeria water bodies are still traditionally farmed and

ponds are unmanaged, this gives rise to the shortage of fish production, therefore it becomes important to expand and develop fresh water fish as a renewable natural resource before most of the fishes goes into extinction. Out of about 268 species of fish in the inland waters of Nigeria only the length-weight relationships (LWR) of 43 (16.04%) species have been reported (Anibeze, 2000). As LWR varies geographically, it is important to obtain and use local LWR values (Merella *et al*., 1997). LWR have many uses particularly in estimating the mean weight of a given length class, in comparing species and populations in different geographic areas and in estimating the condition or "well being" of the fish (Petrakis and Stergiou, 1995; Garcia *et al.*, 1998). This contribution from the Asa River adds to the existing LWR data on Nigerian freshwater fishes.

Length- weight data are useful standard results of fish sampling programs (Morato *et al*., 2001; Mendes *et al.,* 2004). In fisheries, size is generally more biologically relevant than age, mainly because several ecological and physiological factors are more size-dependent. Consequently, variation in size has greater important implications for species diversity and population dynamics (Eizini, 1994). Length – weight regressions have been frequently used to estimate weight from length because direct weight measurements can be time-consuming in the field (Sinovnic *et al.,* 2004). *Clarias* is a fish genus belonging to the family *Clariidae* and it comprises of ten species in Nigeria waters, namely, *C. gariepinus, C. anguillaris, C. jaensis, C. Macromystax, C. albopunctatus, C. agboyiensis, C. buthupogon, C. ebriensis, C pachynema,* and *C. camerunensis* (Olaosebikan and Raji, 1998). *Clarias buthupogon* and *Heterobrachuslongifilis* are the predominant species of the genus found in Asa River. The present work compares the relative abundance and length-weight relationship of *Clarias buthupogon* and *Heterobrachus longifilis* in the polluted Asa River.

MATERIALS AND METHOD

The Study Area

Asa River has a surface area of 302 hectares with a maximum depth of 14 m and is located approximately 4 km south of Ilorin Township (Adekeye, 2004). The river lies between latitude $8^0 28^1$ and $8^0 52^1$N and longitude $4^0 35^1$ and $4^0 45^1$East. The river is very significant to the socio-economic growth of Ilorin and supplies the basic water needs of Ilorin city and its environs after treatment. It also serves as their major source of water for agricultural activities such as irrigation of farmland and most importantly fishing. The river provides fresh fish to the town and serves as water source for both industrial and domestic uses (Adekeye, 2004). More than three quarter (¾) of domestic and industrial water requirements of Ilorin and its environs are supplied from Asa River. Major industries in the town are sited along its bank. The river is also being used for recreational purposes, serving as a tourist attraction centre particularly, and the Asa area.

The downstream portion of the river was used for fish sampling using two sampling sites, FSP1 and FSP2 (i.e. Downstream A and Downstream B respectively) of about 1.8km apart. The climatic condition of the study area is typically tropical as the area lies within the rain forest belt. The rainy season sets-in April and ends in September while the dry season begin in October and last till March.

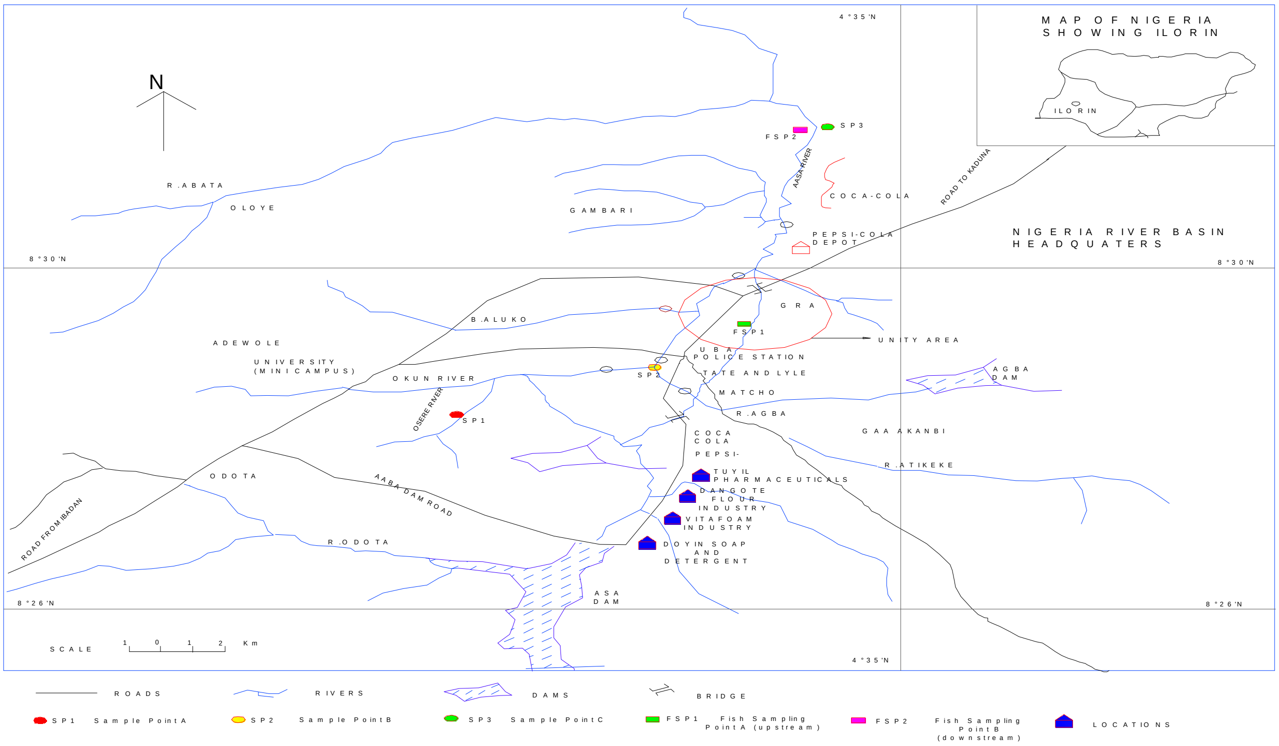

Figure 1: Map Showing Asa River and all the Sampling Sites

The two fish species used in this work were *Clarias buthupogon* and *Heterobranchus longifilis*, both of which are the predominant species in the water body. Fishing was usually done using different gill nets consisting of 25 mm, 38 mm, 51 mm, 64 mm, 102 mm, 114 mm and 127 mm. Fish samples were also collected using hooks of various sizes, traps and cast nets. Fishing was done twice monthly starting from April, 2011 to March, 2013. The collected fish samples were identified immediately after collection using the methods of FAO (1992) and Olaosebikan and Raji (1998).

Monthly catches of *C. buthupogon* and *H. longifilis* were mopped and cleaned with filter papers and weighed to the nearest 0.1g Loadind Mettler Model PM 2000 for small fishes and Salter Model 180 for larger species. The total length was measured from the tip of the Snout to the tip of the caudal fin while the standard length was taken from the tip of the snout to the base of the caudal fin using a standard measuring board. Length frequency distribution was also determined by plotting the frequency of occurrence throughout the sampling months against standard length, and represented with bar charts. Length – weight relationship was also determined by plotting Log of body weight against Log of standard length and it is expressed by the equation.

$$W = aL^b \qquad (1)$$

Where, W is weight in grammes, L is Length in centimetres, a is regression constant and b is an exponent lying between 2 and 4. This relationship can be transformed into a straight line relationship in the form.

$$\text{Log } W = \text{Log } a + b \text{ Log } l \qquad (2)$$

Where: b is the regression coefficient (slope of the graph) and, a is the regression constant (intercept of the regression line on the Y axis).

RESULTS

Relative Abundance

The percentage occurrence of *Clarias buthupogon* and *Heterobranchus longifilis* in the cast net/cage catches is known as the relative abundance of the two species, as shown in Figure 2. *H. longifilis* was the least abundant having the percentage composition of 49.71% while *C. buthupogon* had 50.29% catch between the period of April, 2011 to March, 2013. Although the difference in percentage catch was not statistically significant.

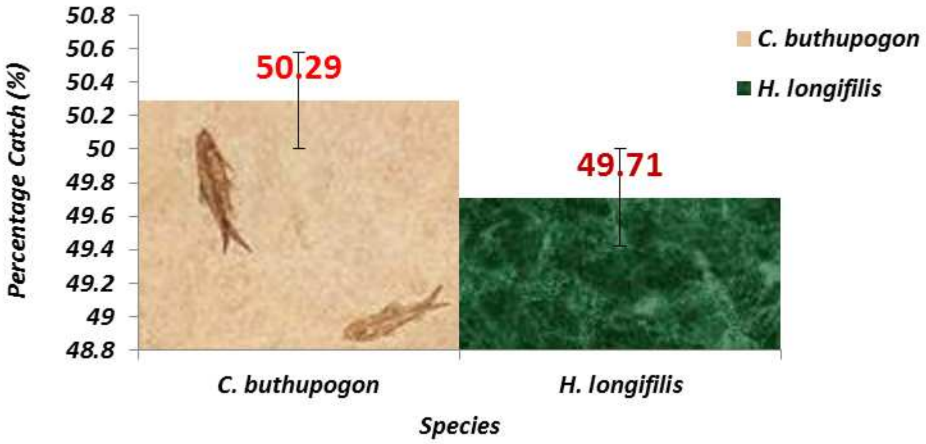

Figure 2: Relative Abundance of *C. buthupogon* and *H. longifilis* Sampled from Asa River

The proportion of *C. buthupogon* and *H. longifilis* collected from the downstream A and downstream B portions of Asa River with the same fishing effort and method were 49.04% and 50.96% respectively. The study showed that, the number of the fishes caught in the two sampling locations was closely similar in terms of values obtained. Figure 3 also revealed that more fishes were found in the downstream than in the upstream.

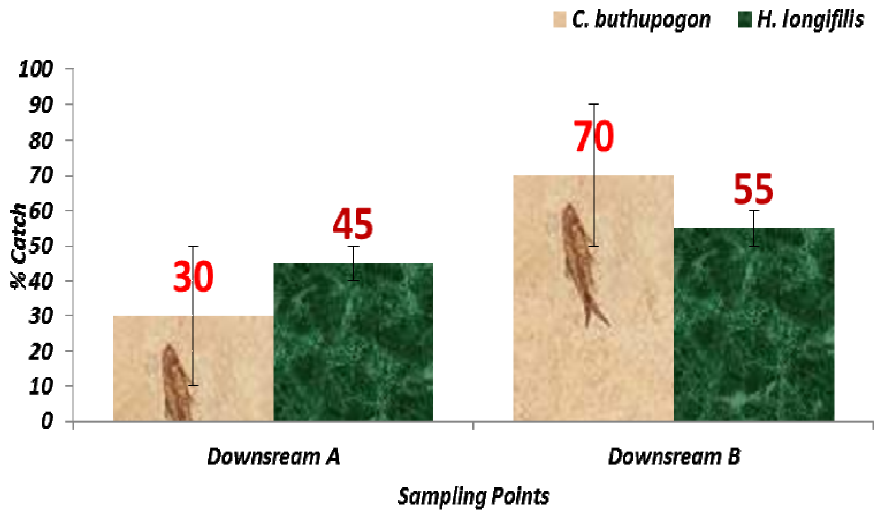

Figure 3: Spatial Distribution of *C.buthupogon* and *H.longifilis* in Asa River

Seasonal Distribution

An increase in the level of water and water depth were observed during the rainy season while there was decrease in the volume of water in the dry season, a situation that exposed large area of shore line. The total number of the two

species caught during the rainy season was higher than that obtained during the dry season with the same fishing effort (Figure 4). The percentage catch of *C. buthupogon* per catch effort for dry and rainy seasons were 27.77% and 72.23% respectively, while *H. longifilis* recorded 44.52% and 55. 48% for dry and rainy seasons respectively. Thus, more fishes were caught in the rainy season than in the dry season.

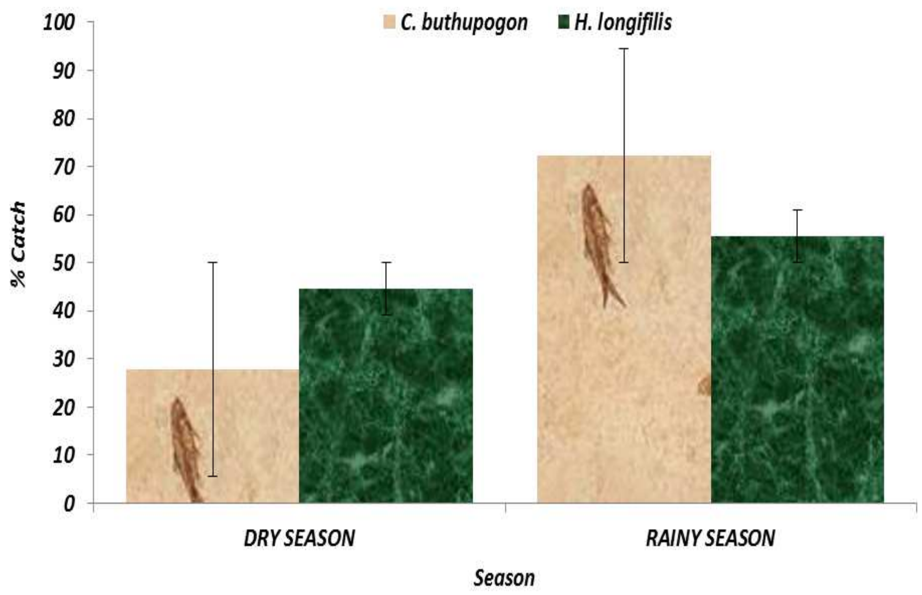

Figure 4: Seasonal Distribution of *C.buthupogon and H.longifilis in* Asa River

Annual and Monthly Distribution

Figure 5, shows the annual distribution in terms of numerical catches of *C. buthupogon* and *H. longifilis* in Asa River, with the first sampling year (April, 2011 – March 2012) having 296 and 301 number of fishes respectively while *C. buthupogon* had 220 and *H. longifilis* had 200 number of fishes in the second sampling year (April, 2012 – March, 2013). Figure 6 showed the monthly percentage catches of *C. buthupogon* in Asa River for the whole sampling period showed that the lowest catch of 5.2% was obtained in January while the highest catch of 10.83% was recorded in the month of April, while the same trend was recorded for *H. longifilis*. Generally, more fishes were caught in the months that coincide with the emergence of the rainy season (April).

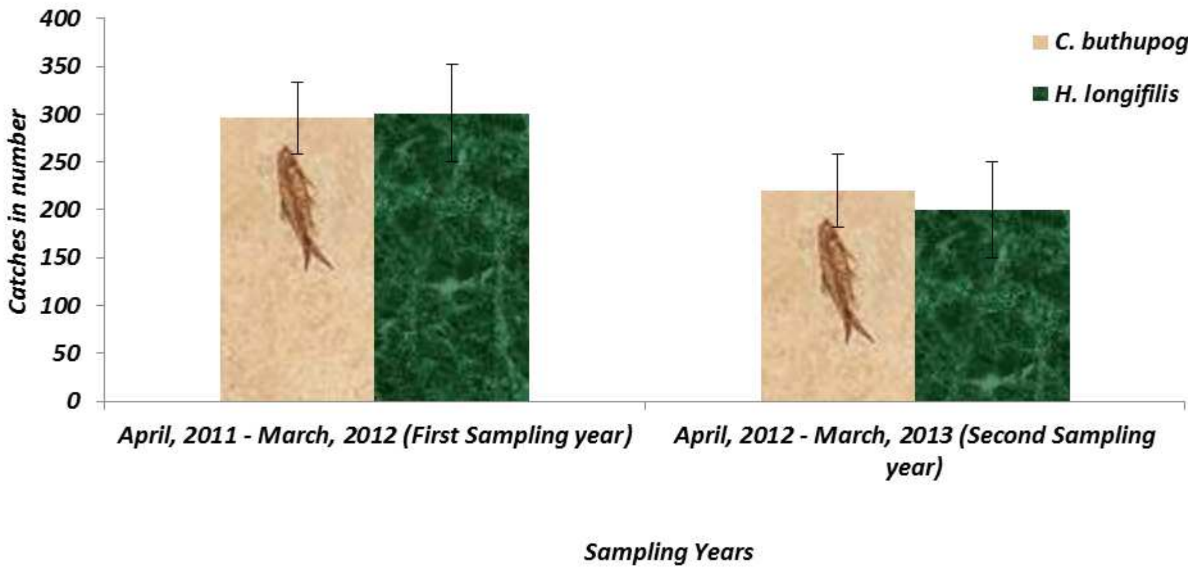

Figure 5: Relative Annual Distribution of *C.buthupogon* and *H.longifilis* in Asa River

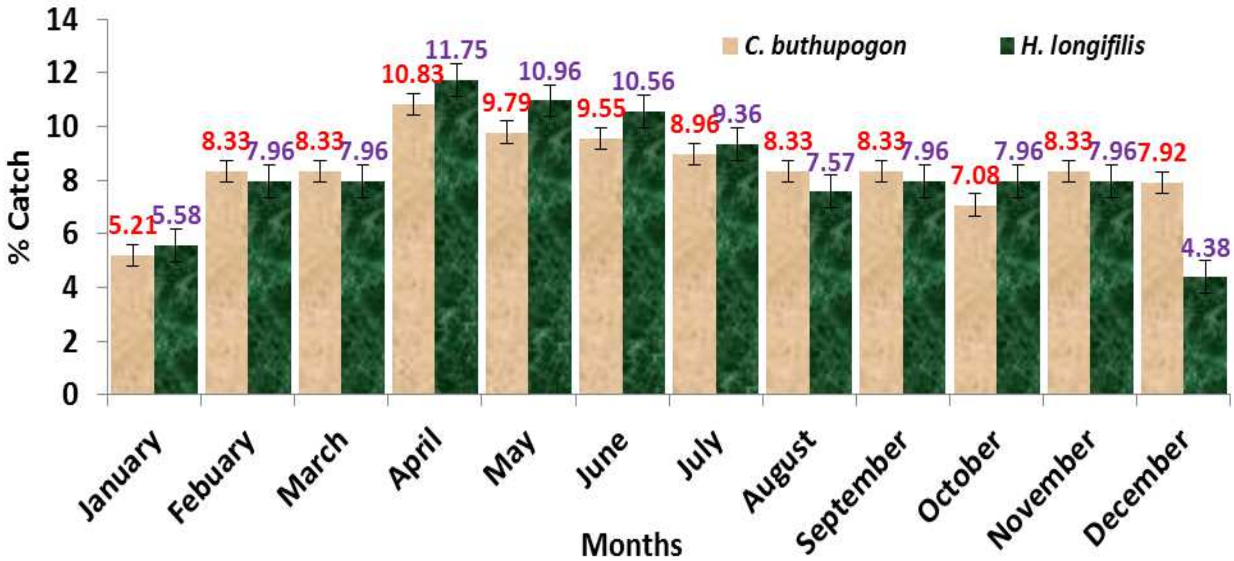

Figure 6: Variations in the Monthly Abundance of *C.buthupogon* and *H.longifilis* in Asa River

Size Distribution

A total of 516 and 501 numbers of *C. buthupogon* and *H. longifilis* were respectively caught during the entire period of study. The smallest specimen caught for *C. buthupogon* had a total length of 11.4 cm, standard length of 8.6cm and a total weight of 5.0g while the biggest specimen caught had a total length of 48.5 cm, standard length of 43.2 cm and a total weight of 50 g. For *H. longifilis* the smallest specimen caught had a total length of 23.4 cm, standard length of 20.0 cm and a total weight of 80 g, and the biggest specimen had a total length of 65.3 cm, standard length of 62.8 cm and a total weight of 2,700 g. The length frequency distribution patterns of *C. buthupogon* and *H. longifilis*

recorded in this work indicates that a wide range of sizes of these fishes were caught during the sampling period. However, *C. buthupogon* with the standard length of between 15.0 cm and 19.9 cm and 20.0 cm and 24.9 cm were more abundant than other groups, while in *H. longifilis*, the specimen with mean standard length of between 30.0 cm and 34.9 cm and 35.0 cm and 39.9cm were found to be more abundant than other groups.

Length-Weight Relationship

The length-weight relationships were significant for all categories of sampled species (Table 1). The determination coefficient r^2 for *C. buthupogon* ranged from 0.644 to 0.908 for downstream A and in the dry season of the first and second sampling years (2011/2012 and 2012/2013). In terms of growth type, the results showed that *C. buthupogon* exhibits negative allomeric except in the downstream A of the first sampling year where the test organism reflects a positive allometric type of growth. The coefficient of determination (r^2) for *H. longifilis* ranged from 0.234 to 0.985 with the value of b ranged between 2.19 to 4. 81, but in terms of growth type, the results showed that, negative allometric growth was the order of the day except for few that exhibit positive allometric, while an isometric growth was noticed in the dry season with *H. longifilis*.

Table 1: Length-Weight Relationship of *C. buthupogon* and *H. longifilis* Collected from Asa River

Species/Date	Sex	N	R^2	SD (b)	$W = aL^b$ b	a	Growth Type
April, 2011 - March, 2012							
C. buthupogon	Combine Sexes	262	0.814	0.123	2.78	0.95	-veAllometric
H.longifilis	Combine Sexes	240	0.811	0.190	4.06	0.99	+veAllometric
April, 2012 - March, 2013							
C. buthupogon	Combine Sexes	214	0 .761	0.165	1.76	1.043	-veAllometric
H. longifilis	Combine Sexes	238	0.840	0.198	4.71	0.99	+veAllometric

NOTE: -ve = Negative, +ve = Positive, SL = Standard length, TL = Total length, N = Sample size, R^2 =Determination coefficient, SD = Standard Deviation and b = Slope

DISCUSSIONS

In this study, the results showed that *C. buthupogon* and *H. longifilis* were well distributed in Asa River. In numerical terms, the most abundant species was *C. buthupogon* with a total catch of 516 while 501 of *H. longifilis* (figure 2) which translated to 50.29% and 49.71% respectively. However, it was discovered that the species were more concentrated in the downstream B part of the river than in the upstream (figure 3). The decline observed in downstream

A may be attributed to high pollution load noticed upstream and such distribution guarantees the fish enough space to search for food with little or no competition. The general pattern of distribution and abundance of these species in Asa River supported the conceptual models proposed by other researchers, in that there was downstream increase in the species diversity and abundance (Fawole, 1998; Ostrand and Nilde 2002). However this pattern was complicated by the occurrence of *clarrids*, which can migrate throughout the length of the stream (Fievet *et al.,* 2001; Joy and Death 2001).

As a result of various timing of migration and recruitment throughout their lifecycles and the large variation in abundance, clariids in Asa River exhibited a complex seasonal pattern in fish assemblage structure.

Seasonally, there were more fish specimens caught during the high flow (i.e Rainy season) than the low flow (Dry season) period of the year with the same fishing efforts of 24 cast nets. The percentage catch for the rainy and dry seasons was 72.23% and 27.77% respectively for *C. buthupogon* while 55.48% 44.52% were recorded for *H. longifilis*; this maybe due to more volume of water noticed during the rainy than in the dry season and this may also be linked to the manifestation of an increased turbidity which brought about a decrease in the visibility and consequently the inability of such species to avoid cast/gill nets or cages, hence they were caught in fairly greater numbers. Also, an increase in water volume due to the floods and the higher rate of inflow of water might have forced many fish specimens downstream and thus resulting in their being caught in greater numbers than in the dry season. Relatively, more fish species were encountered during the first year of study which corresponds to April,2011 to March, 2012 while there was a decline in the population of fish caught the following year (i.e April 2012 to March 2013); this may be connected to the increased pollution status of the river as year progresses (figure 5). The two specimens were available all round the year, with the lowest catch recorded in December and January that corresponds to the peak of the dry season, while the highest catch was obtained between the months of April through July which coincided with the peak of rainy season. Low catches observed during the peak of dry season may probably be due to extremely cold weather prescribed by harmattan during this period and this may also be attributed to environmental factors such as river flows and temperature (Fawole, 1998). Also, it may be linked to a wide variety of distribution and changes in environmental quality (Jonsson *et al*., 1999). However, the anthropogenic factor that probably contributes most to the decline of such fish species is the destruction, degradation or reduced quality of their habitat through pollution, water diversion due to waste and probably construction of barriers to migration (Jonsson *et al.,* 1990).

The total diversity and overall abundance of clariids species was generally less at downstream A section of the river when compared to those downstream B and this conformed with previous studies of riverine fish communities (Gehrke and Harris 2000; Gehkre *et al.,* 2002; Chessman *et al*., 2006), while Jowett and Richardson 1996; McDowell 1998 and Holmquist *et al.,* 1998 reported increased diversity of such species in the downstream. Moreover, variation in year-class strength can be an important source of bias in estimates of relative abundance between sampling locations (Kerstan, 1991). However, this was not the case in this present study because no statistical differences in relative abundance were found between location/habitats in any year. A similar trend in seasonal relative abundance was observed for both sample locations. The lowest relative abundance was found in the dry season and became greatly increased in the rainy season (figure 4) and this may be linked to the inflow of more species from the dam areas when water volume overshoot its boundary during rainy season, while the decline in abundance during the dryseason likely reflected a seasonal movement of large fish to shallow offshore areas or among smaller individuals to bury in shallow sediments (Gehkre *et al*., 2003). Although, availability of food may also be a factor in habitat selection and increased species caught

at downstream site of Asa River, and this may be linked to availability of wide varieties of food and this is in consonance with the submissions of Gehkre *et al.,(*2003) and Fawole and Adewoye, (2004).

C. buthupogon in the range of 15.0 cm – 19.9 cm for male and 20.0 cm – 24.9 cm for female were found to be more abundant; while in *H. longifilis*, the specimens with the mean length of between 30.0 cm–34.9 cm for male and 35.0 cm–39.9 cm for female were noted to be more abundant than other groups, this is an indication that a wide range of these species can be found in Asa river. The logarithmic plots of log of weight against log of total length showed a linear relationship which suggest that an increase in length may lead to an increase in body weight. The correlation coefficient (r^2) between weight and length were fairly high for the two studied species and this is an indication that there is a high degree of correlation between weight and length in the sampled fishes, its positive values reflects that the slope s are positive. It has been proved that, the closer the r^2 value to a unity (i.e. 1) the better the relationship. However, the values of the regression coefficient (b) for the two *Clariid* species and for the entire period of study were significantly different ($p>0.05$) from 3.0 which is an indication that the *Clariids* fish species in Asa river exhibits different growth pattern, ranging from isometric, positive allometric and negative allometric, but the most common growth pattern observed in this work is negative allometric which is predominant two sample locations and this is irrespective of sex which implies that the fish species may be longer than its weight or weight increases faster than its length. This observation may be attributed to over-fishing by the natives owing to easy accessibility to the sampling stations, hence making it difficult for the species to grow to a sizeable population; this may be unconnected to effluents discharges from industries within the vicinity which also impacted negatively on the size of the species harvested. This could also be linked to high pollution index experienced at the downstream A portion of the river due to direct gross discharge of industrial effluents, domestic wastewaters within the vicinity which also impacted negatively on the size of species harvested or may be due to the feeding activities of these species, since they are benthic feeders. This result is in conformity to the submission of Fawole and Adewoye, (1998); Fawole and Arawomo, (1998); Fawole and Arawomo, (1999) who reported allometric growth in *Sarotherodon galilaeus* in Opa reservoir with a regression coefficient of 2.43. The result obtained in this work also supported the observation of Odedeyi, *et al.,* (2007), who also reported allometric growth pattern in *Johniusbel angerii* due to high chemical pollutants like fluoride in the Arabian Sea with a regression coefficient of 0.47.

According to Adeyemi *et al.,* (2009), negative allometric growth pattern in fish implied that the weight increases at a lesser rate than the cube of the body length. King (1996) reported similar growth pattern in many fishes in Nigeria freshwater. Negative allometric growth have also been reported for *H. longifilis* from Idodo River, Nigeria (Anibeze, 2000), Mormyrusrume from River Osse, South Western Nigeria (Odedeyi, *et al*., 2007) and Parachana obscura from Igwu and Itu Rivers wetlands, Nigeria (Bolaji, *et al*., 2011). However, unlike the results in this present work, isometric growth were reported for *Malapterurus electricus* from the lower Borno River, Nigeria (Garba and Arome, 2006) and for *Ethmalo safrimbriata* and *Ilisha Africana* from Nkaro River, Nigeria (Abowei *et al.,* 2009) and positive allometric growth pattern was reported for *Hemichromis niloticus* from Kainji lake (Yem *et al*., 2007). The differences recorded between the results of this work and other previous and afore-mentioned could be attributed to differences in fish species, age, and sex, fecundity of the fishes, sampling method, sample size and most importantly the prevailing environmental conditions in different water bodies.

The values of the regression coefficient calculated for both species as shown in table 1 revealed that, b value for *H. longifilis* for the two sampling years were better than what was recorded for C. *buthupogon. H. longifilis* has 4.06 and

4.71 for 2011/2012 and 2012/2013 respectively, both of which translated to positive allometric growth, while *C. buthupogon* had 1.19 and 3.59 for 2011/2012 and 2012/2013 respectively which translate to negative and positive allometry growths. This is an indication that, *H. longifilis* became heavier with an increase in length and this may be attributed to the fact that, *H. longifilis* is a hybrid species of the *Clariidae* family. Generally, seasonal changes seem not to have any noticeable effect on the growth pattern of the two species. The two sampling locations recorded negative allometric growth and this may be linked to the high pollution index noticed in the two locations (Eizini, 1994). For all the two studied species, the b values were generally in agreement with previous work. It is known that the functional regression ‘’ b ‘’ value represents the body form, and it is directly related to the weight affected by ecological factors such as, temperature, food supply, spawning conditions and other factors like sex, age, fishing time and area, and fishing vessels (Ricker, 1973).

Generally, fishing activities was not observed at sampling site B but relatively low at site C where fish samples were taken for analyses in this study. This is an indication that it is highly probable that the streams are polluted. The body size and weight of the two species sampled is adversely affected in these polluted waters. The predominant growth pattern exhibited by the sampled fish species was negative allometry which indicated that the increase in length of these fishes are not proportional to increase in weight and this could be due to the effects of the pollution status of the river. Hence, there is need for further studies on the reproductive potential, food and feeding habits and as well as the condition factor of such edible fisheries in Asa River.

CONCLUSIONS

The body size and weight of the two species sampled is adversely affected in these polluted waters. The predominant growth pattern exhibited by the sampled fish species was negative allometry which indicated that the increase in length of these fish is not proportional to increase in weight and this could be due to the effects of the pollution status of the river. There were significant variations in the mean values of the two sampled fish species for the two years in terms of percentage compositions. Also, significant seasonal variations occurred between the mean values of dry and rainy seasons. The rainy season had higher value than the dry season.

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